Attorney Docket No. 1293.1633

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In re Patent Application of:

Kyung-geun LEE et al.

Application No.: Unassigned | Group Art Unit: Unassigned

Filed: June 23, 2003 | Examiner: Unassigned

For: INFORMATION STORAGE MEDIUM AND METHOD OF RECORDING AND/OR REPRODUCING DATA THEREON

SUBMISSION OF VERIFIED TRANSLATION OF PROVISIONAL APPLICATION

Commissioner for Patents
PO Box 1450
Alexandria, VA 22313-1450

Sir:

In accordance with the provisions of 37 C.F.R. § 1.78, the applicants submit herewith a copy of the following:

Verified translation of: U.S. Provisional Application No. 60/433,968
Filed December 18, 2002

It is respectfully requested that the applicants be given the benefit of the filing date of the above-identified U.S. Provisional Application, in accordance with 35 U.S.C. § 119. If there are any fees associated with filing of this Submission, please charge the same to our Deposit Account No. 19-3935.

Respectfully submitted,

STAAS & HALSEY LLP

Date: June 23, 2003

By: _____
Michael D. Stein
Registration No. 37,240

700 11th Street, N.W., Ste. 500
Washington, D.C. 20001
(202) 434-1500

IN THE MATTER OF

U.S. Provisional Application No. 60/433,968

By Samsung Electronics Co., Ltd

I, So-hee Kim, an employee of Y.P.Lee & Associates of The Cheonghwa Bldg., 1571-18 Seocho-dong, Seocho-gu, Seoul, Republic of Korea, hereby declare that I am familiar with the Korean and English language and that I am the translator of U.S. Provisional Application and certify that the following is to the best of my knowledge and belief a true and correct translation.

Signed this 24th day of March 2003

Sohee Kim

ABSTRACT

[Abstract of the Disclosure]

Provided are an information storage medium and a method of recording and/or reproducing data on the information storage medium. In the information storage medium, information about a user data area where user data is recorded is recorded in at least one of an area right before and an area right after a basic recording unit of the user data area. In the method of recording and/or reproducing the information storage medium, first, information about a user data area where user data is recorded is read from at least one of two areas right before and after the user data area. Then, the user data area is recognized using the read information.

[Representative Drawing]

FIG. 8

SPECIFICATION

[Title of the Invention]

Information storage medium and a method of recording and/or reproducing data thereon

[Brief Description of the Drawings]

FIG. 1 shows a general single-layer optical disk;

FIG. 2 shows the address structure of an ECC block of a recordable optical disk;

FIG. 3 shows the address structure of an ECC block of a reproduction-only optical disk;

FIG. 4A shows the sector address structure of a conventional two-layer DVD-ROM;

FIG. 4B shows a configuration of lead-in and lead-out areas of a conventional opposite track path (OTP) type DVD-ROM having four information storage layers;

FIG. 4C shows a configuration of lead-in and lead-out areas of a conventional OTP type DVD-ROM having four information storage layers;

FIG. 5 shows a configuration of lead-in and lead-out areas of a conventional parallel track path (PTP) type DVD-ROM having two information storage layers;

FIG. 6 shows a data structure of a lead-in area or a lead-out area of a recordable information storage medium related to the present invention;

FIG. 7 schematically shows the entire structure of a reproduction-only information storage medium related to the present invention;

FIG. 8 is a flowchart illustrating a method of recording and/or reproducing data on an information storage medium according to a first embodiment of the present invention;

FIG. 9 is a flowchart illustrating a method of recording and/or reproducing data on an information storage medium according to a second embodiment of the present invention;

FIG. 10 shows a basic user data area unit of an information storage medium according to an embodiment of the present invention, to which information about the user data area is recorded;

FIG. 11A shows a recording area unit of an information storage medium according to the present invention; and

FIG. 11B shows a sequence of recording area unit.

< Explanation of reference numerals and characters of major elements in the drawings >

A, 43... user data area
B, 40... lead-in area
C, 45... lead-out area
47... groove track
48... land track
49... groove wobble
50... pit

[Detailed Description of the Invention]

[Object of the Invention]

[Technical field of the Invention and Prior art belonging to the Invention]

The present invention relates to an information storage medium and a method of recording and/or reproducing data thereon, and more particularly, to an information storage medium in which information about a user data area is recorded on the inside and/or outside of a basic recording unit of the user data area, and a method of recording and/or reproducing data on the information storage medium.

General information storage media are widely used as information recording media of optical pickup apparatuses for recording/reproducing information in a non-contact way. Optical disks, which are information storage media, are classified as compact disks (CDs) or digital versatile disks (DVDs) according to their information storage capacity. Examples of recordable optical disks are 650MB CD-R, CD-RW, and 4.7GB DVD+RW. Furthermore, HD-DVDs having a recording capacity of 20GB or greater are under development.

As shown in FIG. 1, a general optical disk includes a lead-in area (B), a user data area (A), and a lead-out area (C), which are sequentially formed from the inner boundary R_{in} to the outer boundary R_{out} of the optical disk. In the general optical disk, the number of sector addresses increases from the inner boundary R_{in} to the outer boundary R_{out}. The user data area A includes a plurality of error correction code (ECC) blocks.

As shown in FIG. 2, information about the address of each ECC block is recorded as a groove wobble in a recordable optical disk because data may be

randomly recorded or reproduced regardless of the sequence of physical addresses of basic recording units. In particular, if physical addresses are recorded as a groove wobble, information about a user data area is recorded as a groove wobble. However, the recordable optical disk has a layer and does not include layer information. It is difficult to keep consistency between the formats of the recordable optical disk and reproduction-only optical disks.

As shown in FIG. 3, in a reproduction-only optical disk, each ECC block is comprised of a total of 16 sectors from a zeroth to a fifteenth sector, and a sector address (SA) is recorded at the head of each of the sectors that constitute the ECC block. In other words, reproduction-only optical disks store information about user data, that is, address information, in the ECC blocks of a user data area.

Meanwhile, in contrast to recordable optical disks, reproduction-only optical disks have no grooves in a user data area, which makes it necessary to record information about the user data area in a different way than in recordable optical disks.

Recordable optical disks and reproduction only optical disks have been developed so that they have greater recording capacities. Recording capacity can generally be increased by shortening the wavelength of a recording optical source or by increasing the numerical aperture of an objective lens. However, recording capacity can also be increased due to the inclusion of a plurality of storage layers.

A DVD-ROM having a plurality of information storage layers is disclosed in U.S. Patent No. 5,881,032, entitled "Optical Disk, and Optical Disk Reproduction Method and Apparatus Implementing a Mathematical Complementary Relationship for Plural Layers".

FIG. 4A shows the sector address structure of the disclosed optical disk having two information storage layers. Referring to FIG. 4A, the disclosed optical disk includes first and second information storage layers L_1 and L_2. The first and second information storage layers L_1 and L_2 have lead-in areas 1a and 2a, respectively, and lead-out areas 1b and 2b, respectively. In the first information storage layer L_1, sector address numbers (X) increase from the inner boundary R_{in} to the outer boundary R_{out}. In the second information storage layer L_2, sector address numbers (X') increase from the outer boundary R_{out} to the inner boundary R_{in}.

Multi-layer optical disks having at least two information storage layers are classified as opposite track path (OTP) type optical disks or parallel track path (PTP)

type optical disks according to a direction in which information is reproduced. As shown in FIG. 4B, in OTP optical disks, the first information storage layer L_1 is first reproduced from the inner boundary R_{in} to the outer boundary R_{out}, and then the second information storage layer L_2 is reproduced from the outer boundary R_{out} to the inner boundary R_{in}. In other words, track spiraling directions of the information storage layers L_1 and L_2 of the OTP optical disks are opposite.

FIG. 4C shows an OTP multi-layer optical disk having first through fourth information storage layers L_1, L_2, L_3, and L_4. The first through fourth information storage layers L_1, L_2, L_3, and L_4 have first through fourth lead-in areas 1a, 2a, 3a, and 4a, respectively, and first through fourth lead-out areas 1b, 2b, 3b, and 4b, respectively, in such as way that lead-in and lead-out areas alternate in each of the inner and outer boundary areas of the optical disk. Looking at the reproduction direction of the four-layer optical disk of FIG. 4C, the first information storage layer L_1 is first reproduced from the inner boundary R_{in} to the outer boundary R_{out}, the second information storage layer L_1 is then reproduced from the outer boundary R_{out} to the inner boundary R_{in}, the third information storage layer L_3 is then reproduced in the direction of from the inner boundary R_{in} to the outer boundary R_{out}, and the fourth information storage layer L_4 is then reproduced in the direction of from the outer boundary R_{out} to the inner boundary R_{in}.

FIG. 5 shows a PTP two-layer optical disk. Data is first reproduced from the inner boundary R_{in} to the outer boundary R_{out} of the first information storage layer L_1, and then reproduced from the inner boundary R_{in} to the outer boundary R_{out} of the second information storage layer L_2. In other words, the information storage layers of a PTP optical disk are reproduced in the same track spiraling direction. Here, the first information storage layer L_1 has a first lead-in area 1a at its inner boundary area and a first lead-out area 1b at its outer boundary area. Similarly, the second information storage layer L_2 has a second lead-in area 2a at its inner boundary area and a second lead-out area 2b at its outer boundary area.

The lead-in areas 1a, 2a, 3a, and 4a and the lead-out areas 1b, 2b, 3b, and 4b store information about the optical disk. Recordable optical disks also store various conditions of recording. Hence, user data can only be properly recorded on or reproduced from an optical disk by reading information from the lead-in areas and the lead-out areas. In particular, information storage media having a plurality of information storage layers store information about the number of information storage

layers in each information storage layer. Accordingly, information about the number of information storage layers can be detected from any information storage layer.

In recordable information storage media, information about information storage layers, which is necessary upon data recording, must be recorded in a user data area because data recording or reproduction may randomly occur regardless of the sequence of physical addresses of basic recording units. In particular, if the physical addresses are recorded as a groove wobble, the information about the information storage layers can also be recorded as a groove wobble. In this case, upon data recording or reproduction, the information about the information storage layers can be reproduced using a push-pull channel signal.

Meanwhile, reproduction-only information storage media have no groove wobbles formed on their user data area, which makes it necessary to record information about information storage layers in a different way than in recordable information storage media.

[Technical goal of the Invention]

The present invention provides an information storage medium by which information about a user data area can be read using the physical addresses of the user data area or can be read from areas right before and after a basic recording area unit of the user data area, and a method of recording and/or reproducing data on the information storage medium.

[Structure and Operation of the Invention]

According to an aspect of the present invention, there is provided an information storage medium in which information about a user data area where user data is recorded is recorded in at least one of an area right before and an area right after a basic recording unit of the user data area.

Preferably, the basic recording unit of the user data area is one of a physical cluster, an ECC block, a sector, and a frame. It is also preferable that information about the user data area is recorded in at least one of a run-in area and a run-out area that are right before and after the physical cluster, respectively.

Preferably, the information storage medium includes at least two information storage layers, wherein data is recorded in at least one of an area right before and

an area right after the basic recording unit of the user data area in different patterns for different information storage layers.

According to another aspect of the present invention, there is provided a method of recording and/or reproducing data on an information storage medium by first reading information about a user data area where user data is recorded from at least one of an area right before and an area right after the basic recording unit of the user data area and then by recognizing information about the user data area from the read information.

An information storage medium according to the present invention and a method of recording and/or reproducing data thereon according to the present invention will now be described more fully with reference to the accompanying drawings, in which preferred embodiments of the invention are shown.

An information storage medium according to the present invention may be recordable or reproduction-only.

A recordable information storage medium includes a single information storage layer or a plurality of information storage layers. Each information storage layer includes a lead-in area, a user data area, and a lead-out area.

Referring to FIG. 6, at least one of the lead-in area and the lead-out area includes a reproduction-only data zone 10, a rewritable data zone 30, and a connection zone 20, which connects the reproduction-only data zone 10 to the rewritable data zone 30.

The reproduction-only data zone 10 stores basic information about the information storage medium in the form of pits or a high frequency groove wobble. The reproduction-only data zone 10 includes an information storage medium related information zone 10a where the size, version number, and recording conditions of the information storage medium are recorded.

The connection zone 20 may include a transition zone for transiting between the reproduction-only data zone 10 and the rewritable data zone 30. Alternatively, the connection zone 20 may include a mirror zone or a wobble groove zone.

The rewritable data zone 30 may include an information storage medium test zone 30a, a drive test zone 30b, an information storage medium control data zone 30c, and a defect management zone 30d. The information storage medium control data zone 30c includes at least one information storage medium control region to record information about control of the information storage medium. In FIG. 6, the

information storage medium control data zone 30c includes first through fourth information storage medium control regions 30c-1, 30c-2, 30c-3, and 30c-4. The information storage medium control data zone 30c may further include later at least one reserved area, for example, reserved areas 30c-5 and 30c-6, to record other information. For example, data may be recorded in the user data in the form of a groove wobble.

Meanwhile, reproduction-only information storage media include at least one information storage layer which includes a lead-in area 40, a user data area 43, and a lead-out area 45 as shown in FIG. 7. The lead-in area 40 and/or the lead-out area 45 record reproduction-only data such as information about the information storage medium, and the user data area 43 records reproduction-only user data.

Groove tracks 47 and land tracks 48 are alternately formed on both the lead-in area 40 and the lead-out area 45. The reproduction-only data, such as information about the information storage medium, is recorded on both sidewalls of each of the groove tracks 47 or land tracks 48 in the form of a high frequency groove wobble 49. An area where data has been recorded as the high frequency groove wobble 49 is referred to as a high frequency data zone.

The user data is recorded as pits 50 when the information storage medium is manufactured. Such an information storage medium corresponds to a hybrid disk and requires different channels for reproduction. In the recordable information storage medium, reproduction only data in the lead-in area is reproduced using a push-pull channel, and user data is reproduced using a sum channel. Similarly, in the reproduction-only information storage medium, the lead-in area can be reproduced using a push-pull channel, and the user data area can be reproduced using a sum channel. In this respect, consistency between recordable information storage media and reproduction-only information storage media can be obtained.

Methods of detecting information about a user data area, for example, information about whether there is only one or a plurality of information storage layers, or information about which information storage layer data is to be reproduced from, from a recordable or reproduction-only information storage medium having the above-described structure will now be described.

Generally, physical addresses are recorded to every basic recording unit of a user data area where data is recorded.

An information storage medium according to a first embodiment of the present invention includes at least one information storage layer.

If an information storage medium has two information storage layers, physical address Nos. 0 to 30000 are recorded in a first information storage layer, and physical address Nos. 30001 to 60000 are recorded in a second information storage layer. Accordingly, the number of information storage layers included in an information storage medium can be detected using these physical addresses. Every time a pickup approaches an optical disk in order to record/reproduce data from the optical disk, the physical addresses of individual basic recording areas are read. Here, if the read physical addresses fall within the range of 0 to 30000, it is recognized that the corresponding basic recording areas belong to the first information storage layer, and on the other hand, if the read physical addresses fall within the range of 30001 to 60000, it is recognized that the corresponding basic recording areas belong to the second information storage layer.

FIG. 8 is a flowchart illustrating a process of searching for a first information storage layer L_1 of an information storage medium having at least one information storage layer. First, in step S100, the information storage medium is loaded on a turntable of an optical recording/reproduction drive. Then, in step S110, an optical pickup device reads information about the information storage medium from the information storage medium. Thereafter, in step S120, the optical pickup device moves to a recording/reproduction layer to record data to or reproduce data from the recording/reproduction layer. At this time, the optical pickup device accesses the recording/reproduction layer to focus and track the same, thereby reading addresses from the tracked recording/reproduction layer. Next, in step S130, it is determined whether the read addresses belong to a predetermined group of addresses. As described above, if it is determined that the read addresses fall within the range of 0 to 30000, the tracked recording/reproduction layer is recognized as the first information storage layer L_1, and accordingly, data is recorded to or reproduced from the first information storage layer L_1, in step S140. However, if it is determined that the reproduced addresses do not fall within the range of 0 to 30000, an optical spot formed by the optical pickup device is focused on another layer, in step S150. Then, in step S160, the process of determining whether read addresses belong to a predetermined group of addresses is repeated. To sum up, if it is determined that read addresses belong to a predetermined group of addresses correspond to a layer

of interest, recording or reproduction is performed on that layer. Otherwise, addresses of another layer are checked. By repeating these processes, the first information storage layer L_1 can be found.

FIG. 9 is a flowchart illustrating a process of searching for first and second information storage layers L_1 and L_2 of an information storage medium. First, in step S100, the information storage medium is loaded on a turntable of an optical recording/reproduction drive. Then, in step S110, an optical pickup device reads information about the information storage medium from the information storage medium. Thereafter, in step S120, the optical pickup device moves to a recording/reproduction layer to record data to or reproduce data from the recording/reproduction layer. At this time, the optical pickup device accesses the recording/reproduction layer to focus and track the same, thereby reading addresses from the tracked recording/reproduction layer. Next, in step S130, it is determined whether the read addresses belong to a predetermined group of addresses. As described above, if it is determined that the read addresses fall within the range of 0 to 30000, the tracked recording/reproduction layer is recognized as the first information storage layer L_1, and accordingly, data is recorded to or reproduced from the first information storage layer L_1, in step S140. However, if it is determined that the read addresses do not fall within the range of 0 to 30000, an optical spot formed by the optical pickup device is focused on another layer, in step S150.

Then, in step S210, it is determined whether read addresses belong to a predetermined group of addresses, for example, a group of addresses numbered 30001 to 60000. If it is determined that the read addresses fall within the range of 30001 to 60000, the tracked recording/reproduction layer is recognized as the second information storage layer L_2, and accordingly, data is recorded to or reproduced from the second information storage layer L_2, in step S220.

Above, processes of searching for first and second information storage layers have been described. In the case of information storage media having three or more information storage layers, processes of searching for any information storage layer or any number of information storage layers are carried out in the same way.

As another method of detecting information about a user data area, there is proposed a method of recording information about a user data area, for example, information about layers, in at least one of two areas right before and after a basic recording unit where data is recorded. The basic recording area where data is

recorded can be a physical cluster, an ECC block, a sector, a frame, or the like, and its capacity is not restricted.

FIG. 10 shows an ECC block composed of a plurality of sectors, and information about a user data area is recorded on the inside and/or outside of the ECC block to serve as address information. Accordingly, the information about the user data area recorded on the inside and/or outside of the ECC block is the address of the ECC block. Preferably, the ECC block address includes layer information that represents the number of information storage layers included in the information storage medium. In other words, the layer information is recorded using an address.

FIG. 11A shows a case in which data is recorded in a physical cluster of an information storage medium according to the present invention. Referring to FIG. 11A, a run-in area and a run-out area are provided right before and after the physical cluster, respectively, to record additional data. FIG. 11B shows a sequence of the physical clusters. Here, information about a user data area, for example, layer information, can be recorded in at least one of the run-in area and the run-out area. In particular, the format of reproduction-only information storage media can be kept consistent with that of recordable information storage media by adopting the above-described layer information recording method.

An information storage medium according to a third embodiment of the present invention includes at least two information storage layers and can store layer information about each of the information storage layers in at least one of the run-in area and the run-out area in such a way that the layer information is recorded in different patterns for different layers.

For example, in information storage media having two information storage layers, the first information storage layer L_1 can be formed in a mark (or pit)-space interval pattern of 5T/5T/5T/5T, while the second information storage layer L_2 can be formed in a mark (or pit)-space interval pattern of 8T/8T/8T/8T. Such different consecutive patterns of identical intervals enable the number of information storage layers to be recognized.

Alternatively, the first information storage layer L_1 can be formed in a mark (or pit)-space interval pattern of 2T/9T/2T/9T, while the second information storage layer L_2 can be formed in a mark (or pit)-space interval pattern of 9T/2T/9T/2T. Hence,

the number of information storage layers can be recognized by randomly combining different-sized intervals in different patterns.

Consequently, information storage layers can be easily detected by differently patterning at least one of two areas right before and after a basic recording unit of a user data area (e.g., a physical cluster, an ECC block, a sector, a frame, or the like), for example, a run-in area and a run-out area.

[Effect of the Invention]

As described above, in an information storage medium according to the present invention and a method of recording and/or reproducing data thereon, even when a user data area has no groove wobbles, data can be effectively recorded and/or reproduced using various methods proposed to provide information about the user data area, for example, information about whether an information storage medium includes a single layer or a plurality of layers, or information about information storage layers. The proposed methods are effectively applied to reproduction-only information storage media having no groove wobbles, enabling reliable data reproduction. Also, information about a user data area can be recorded on recordable information storage media in various new methods in addition to a method of recording data on a groove wobble.

What is claimed is:

1. An information storage medium in which information about a user data area where user data is recorded is recorded in at least one of an area right before and an area right after a basic recording unit of the user data area.

2. The information storage medium of claim 1, wherein the basic recording unit of the user data area is one of a physical cluster, an ECC block, a sector, and a frame.

3. The information storage medium of claim 2, wherein information about the user data area is recorded in at least one of a run-in area and a run-out area that are right before and after the physical cluster, respectively.

4. The information storage medium of any of claims 1 through 3, comprising at least two information storage layers, wherein data is recorded in at least one of an area right before and an area right after the basic recording unit of the user data area in different patterns for different information storage layers.

5. The information storage medium of any of claims 1 through 3, wherein the information about the user data area is recorded using addresses.

6. The information storage medium of any of claims 1 through 3, wherein the information about the user data area is layer information.

7. The information storage medium of claim 6, wherein the layer information is recorded using addresses.

8. A method of recording and/or reproducing data on an information storage medium, the method comprising:

reading information about a user data area where user data is recorded from at least one of an area right before and an area right after the basic recording unit of the user data area; and

recognizing information about the user data area from the read information.

9. The method of claim 8, wherein the basic recording unit of the user data area is one of a physical cluster, an ECC block, a sector, and a frame.

10. The method of claim 9, wherein information about the user data area is recorded in at least one of a run-in area and a run-out area that are right before and after the physical cluster, respectively.

11. The method of any of claims 8 through 10, comprising at least two information storage layers, wherein data is recorded in at least one of an area right before and an area right after the basic recording layer of the user data area in different patterns for different information storage layers.

12. The method of any of claims 8 through 10, wherein the information about the user data area is recorded using addresses.

13. The method of any of claims 8 through 10, wherein the information about the user data area is layer information.

14. The method of claim 13, wherein the layer information is recorded using addresses.

FIG. 1

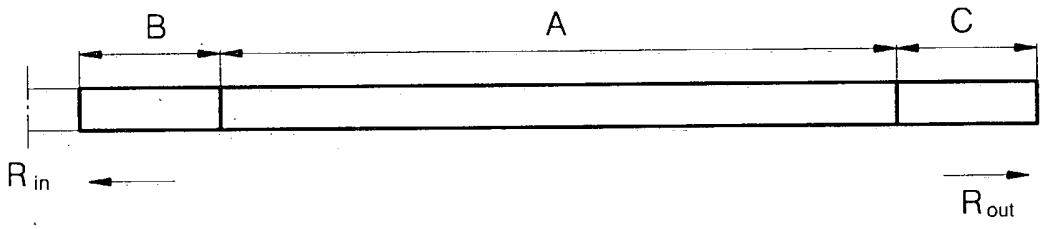

FIG. 2

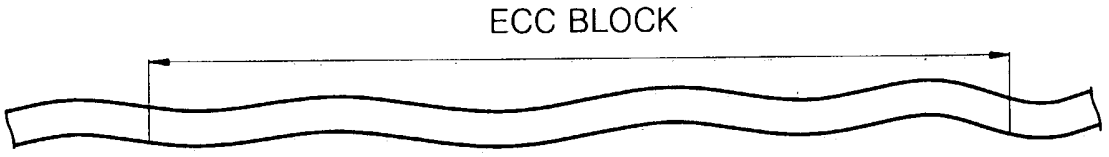

FIG. 3

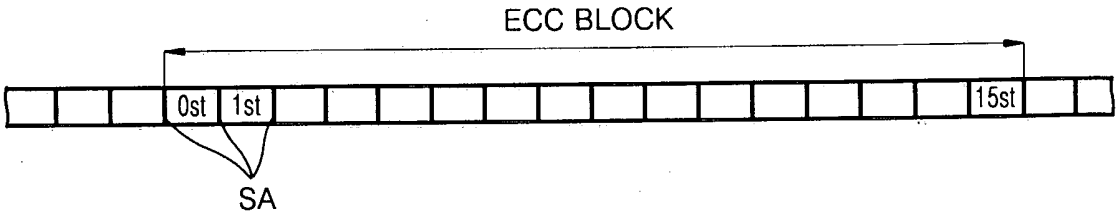

FIG. 4A (PRIOR ART)

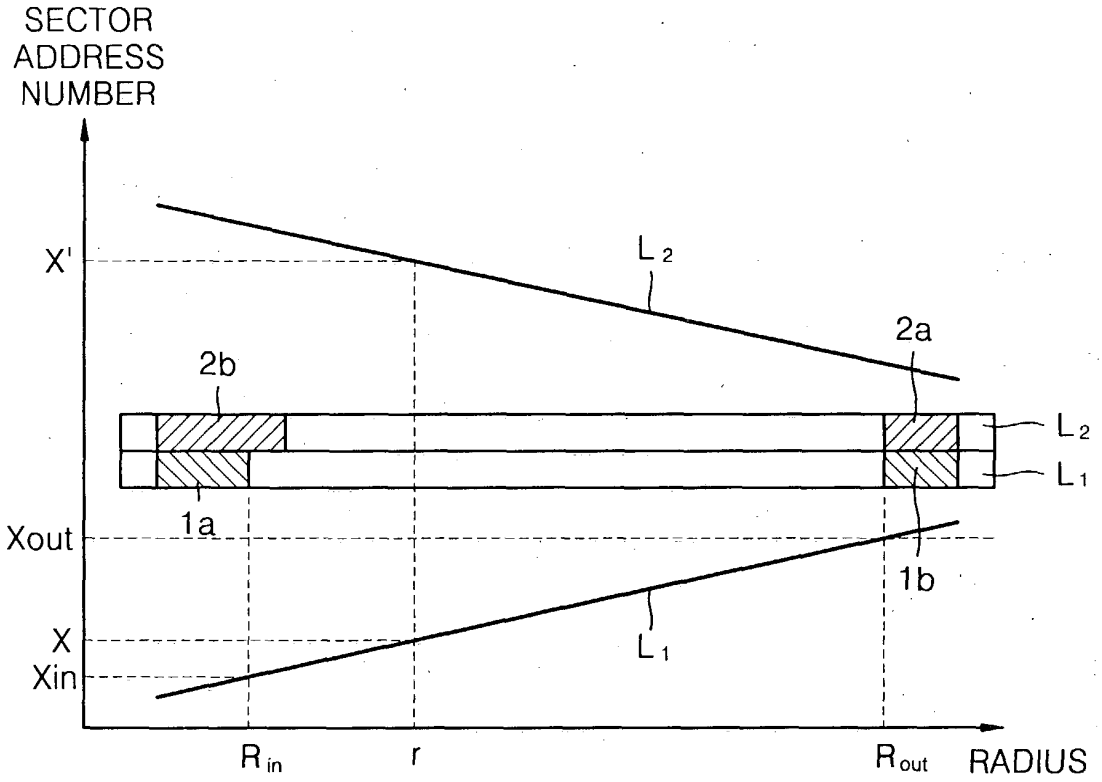

FIG. 4B (PRIOR ART)

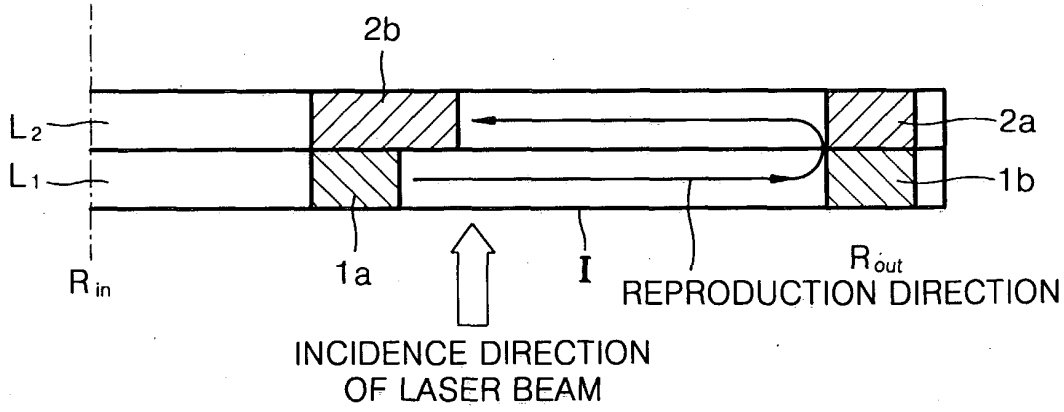

FIG. 4C (PRIOR ART)

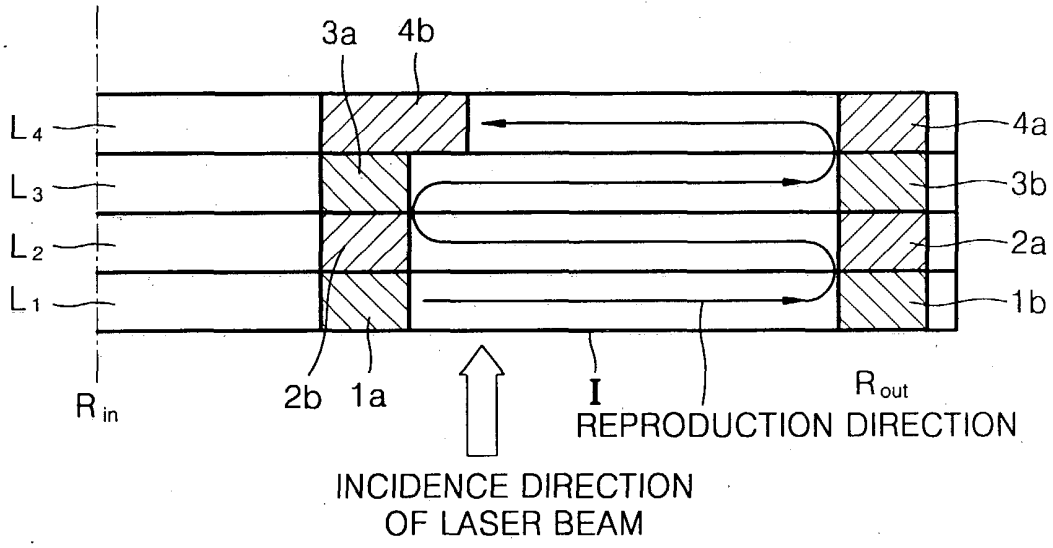

FIG. 5 (PRIOR ART)

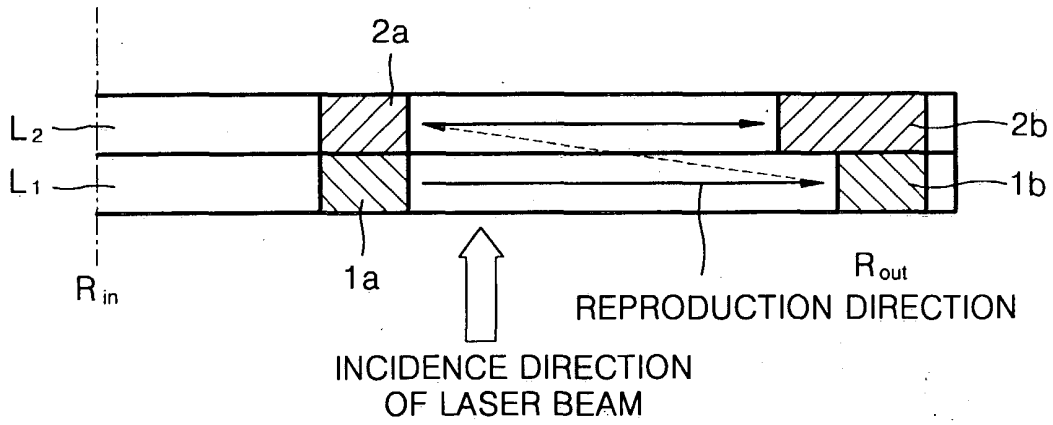

FIG. 6

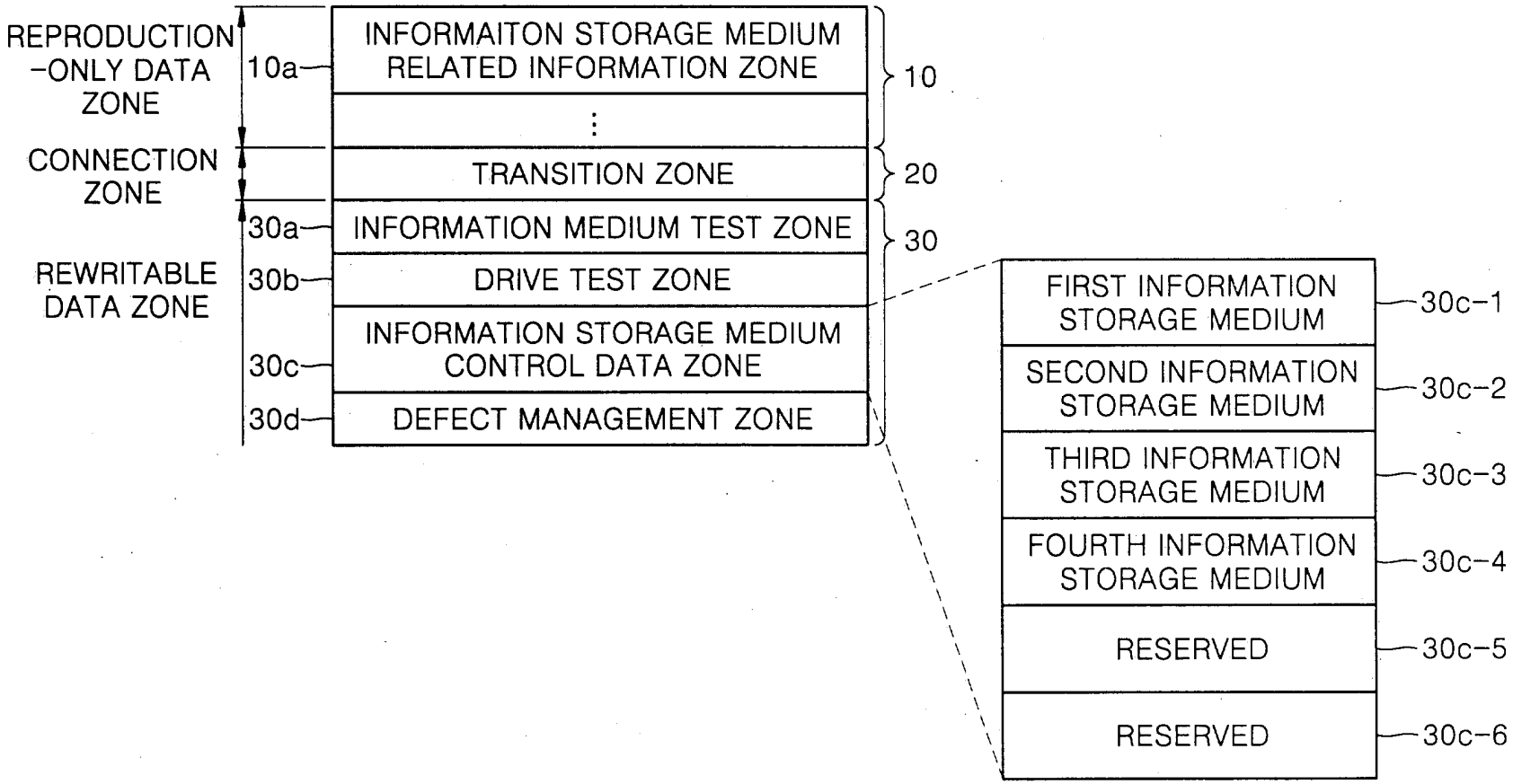
REPRODUCTION-ONLY DATA ZONE
CONNECTION ZONE
REWRITABLE DATA ZONE
10a
INFORMAITON STORAGE MEDIUM RELATED INFORMATION ZONE
10
TRANSITION ZONE
20
30a
INFORMATION MEDIUM TEST ZONE
30
30b
DRIVE TEST ZONE
30c
INFORMATION STORAGE MEDIUM CONTROL DATA ZONE
30d
DEFECT MANAGEMENT ZONE
FIRST INFORMATION STORAGE MEDIUM
30c-1
SECOND INFORMATION STORAGE MEDIUM
30c-2
THIRD INFORMATION STORAGE MEDIUM
30c-3
FOURTH INFORMATION STORAGE MEDIUM
30c-4
RESERVED
30c-5
RESERVED
30c-6

FIG. 7

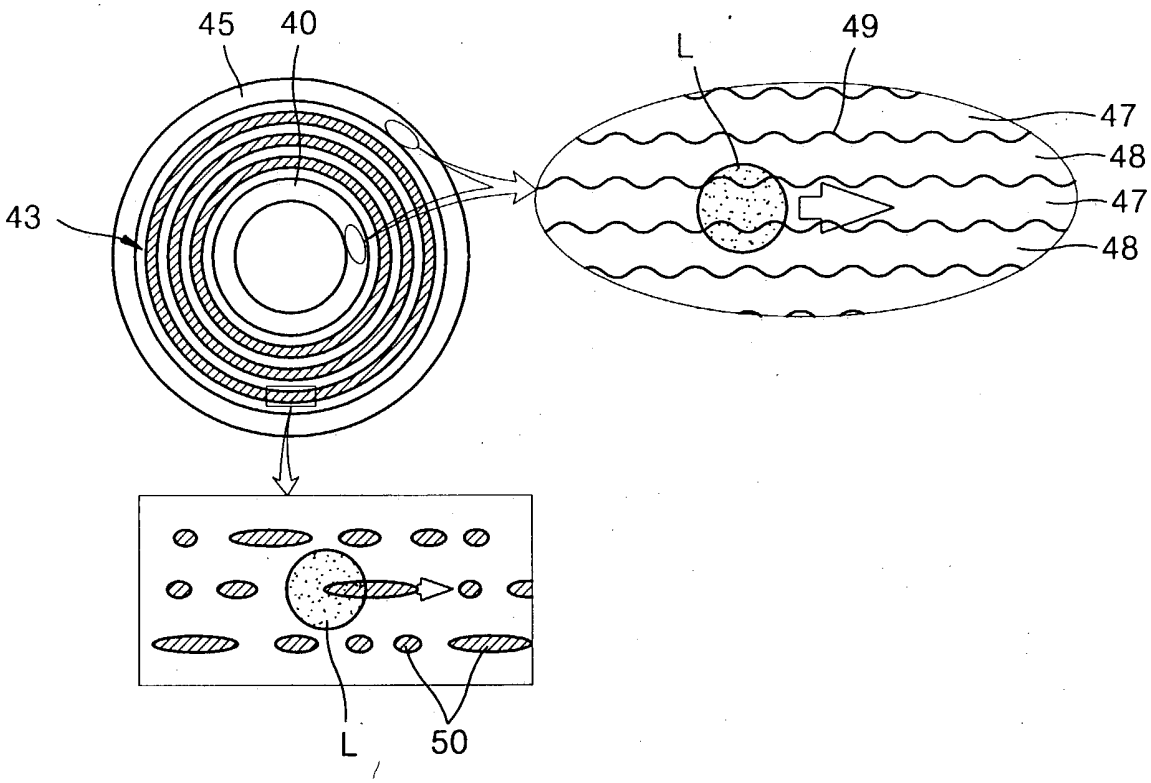

FIG. 8

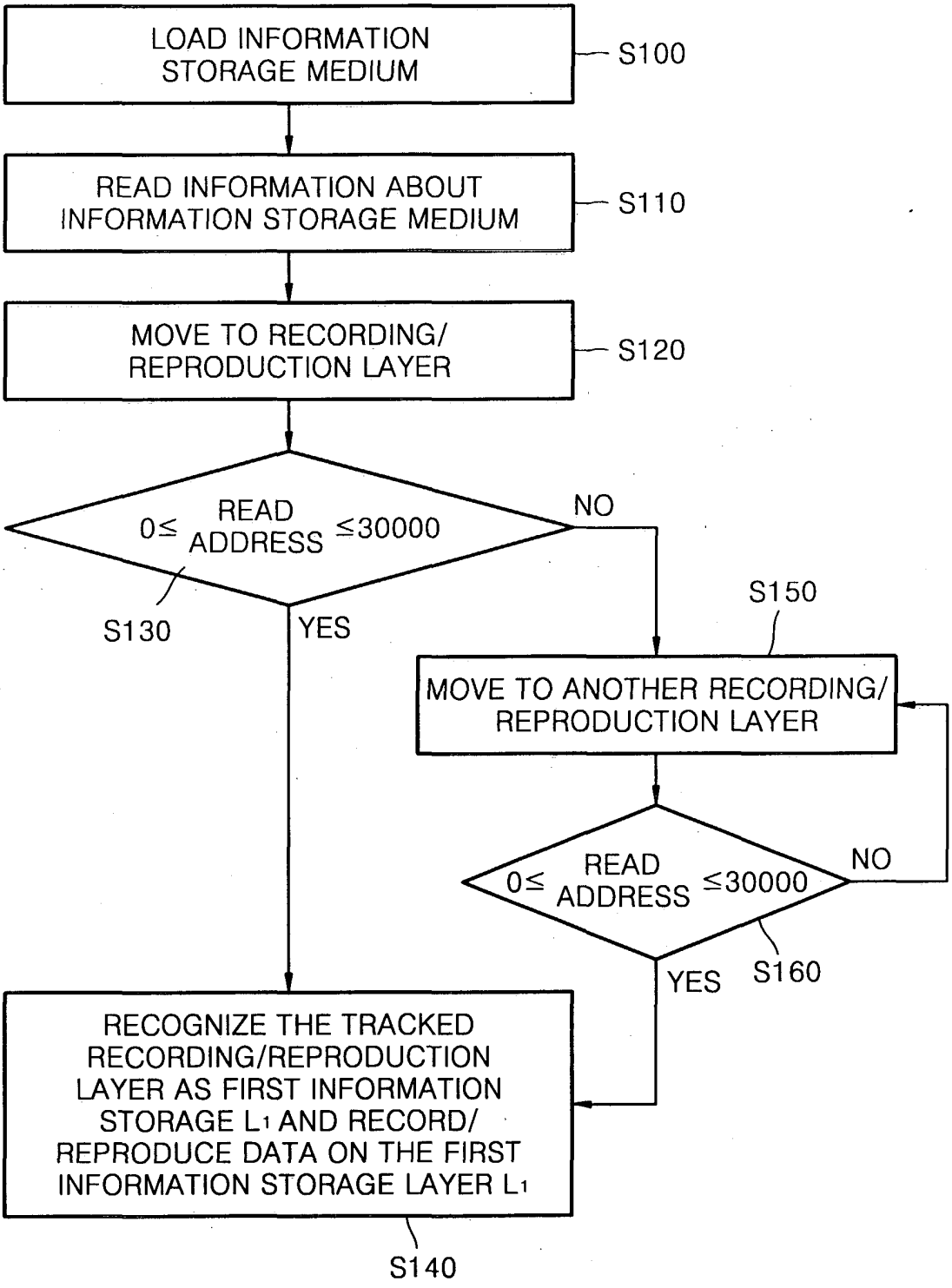
LOAD INFORMATION STORAGE MEDIUM
S100
READ INFORMATION ABOUT INFORMATION STORAGE MEDIUM
S110
MOVE TO RECORDING/ REPRODUCTION LAYER
S120
0≤ READ ADDRESS ≤30000
NO
YES
S130
S150
MOVE TO ANOTHER RECORDING/ REPRODUCTION LAYER
0≤ READ ADDRESS ≤30000
NO
YES
S160
RECOGNIZE THE TRACKED RECORDING/REPRODUCTION LAYER AS FIRST INFORMATION STORAGE L1 AND RECORD/ REPRODUCE DATA ON THE FIRST INFORMATION STORAGE LAYER L1
S140

FIG. 9

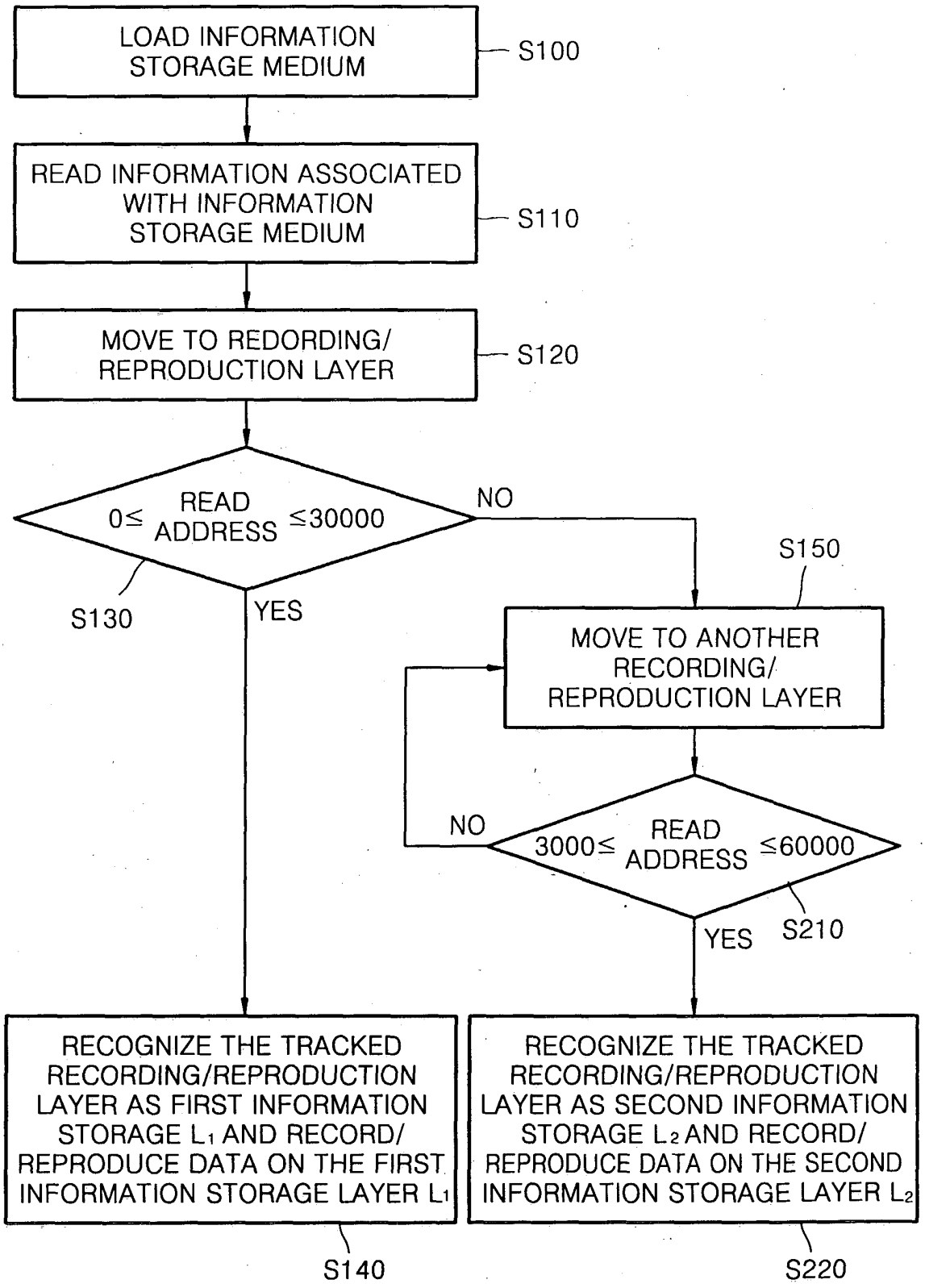
LOAD INFORMATION STORAGE MEDIUM
S100
READ INFORMATION ASSOCIATED WITH INFORMATION STORAGE MEDIUM
S110
MOVE TO REDORDING/ REPRODUCTION LAYER
S120
0≤ READ ADDRESS ≤30000
NO
YES
S130
S150
MOVE TO ANOTHER RECORDING/ REPRODUCTION LAYER
NO
3000≤ READ ADDRESS ≤60000
YES
S210
RECOGNIZE THE TRACKED RECORDING/REPRODUCTION LAYER AS FIRST INFORMATION STORAGE L1 AND RECORD/ REPRODUCE DATA ON THE FIRST INFORMATION STORAGE LAYER L1
RECOGNIZE THE TRACKED RECORDING/REPRODUCTION LAYER AS SECOND INFORMATION STORAGE L2 AND RECORD/ REPRODUCE DATA ON THE SECOND INFORMATION STORAGE LAYER L2
S140
S220

FIG. 10

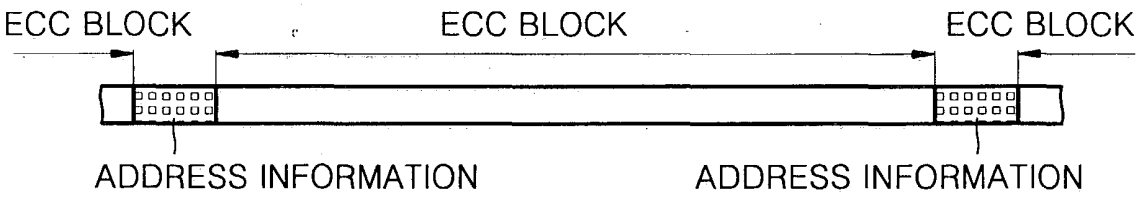

FIG. 11A

FIG. 11B


RUN-IN AREA
PHYSICAL CLUSTER
RUN-OUT AREA
RUN-IN AREA
PHYSICAL CLUSTER
RUN-OUT AREA
RUN-IN AREA
PHYSICAL CLUSTER
RUN-OUT AREA